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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BOARD OF PATENT APPEALS AND INTERFERENCES

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| In re Application of: | | |
| | Volker BECKER et al. | : Examiner: L. Alejandro Mulero |
| For: | DEVICE AND METHOD FOR ETCHING A SUBSTRATE USING AN INDUCTIVELY COUPLED PLASMA | |
| Filed: | May 8, 2001 | : Art Unit: 1763 |
| Serial No.: | 09/762,985 | |

I hereby certify that this correspondence is being deposited with the United States Postal Service with sufficient postage as first class mail in an envelope addressed to: Mail Stop APPEAL BRIEF-PATENTS Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on

Date: 5/22/2007

Signature:
AARON C. DEDITCH
(33,865)

MAIL STOP APPEAL BRIEF - PATENTS
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

## APPEAL BRIEF PURSUANT TO 37 C.F.R. § 41.37

SIR:

In the above-identified patent application ("the present application"), Appellants mailed a Notice Of Appeal on February 20, 2007 – which was filed in the Office on February 26, 2007 --- from the Final Office Action issued by the U.S. Patent and Trademark Office on August 23, 2006, so that the two-month appeal brief due date is April 26, 2007 (since the Notice of Appeal was filed in the Office on February 26, 2007), which has been extended by one month to May 29, 2007 (since May 26, 2007 is a Saturday and since May 28, 2007 is a Federal Holiday) by the accompanying Appeal Brief Transmittal and which Petition to Extend.

In the Final Office Action, claims 42 to 45, 47 to 71 and 74 were finally rejected.

A response After A Final Office Action was mailed on January 19, 2007, and an Advisory Action was mailed on March 7, 2007.

It is understood for purposes of the appeal that any Amendments to date have already been entered by the Examiner, and that the Response After Final does not require entry since it included no amendments.

*The Replacement Appeal Brief is believed to comply with all the requirements of Rule 41.37. It is noted that the "concise explanation" language of the Rule is like the "concise explanation" requirement of former Rule 37 CFR 1.192, and that the length of the concise explanation provided herein should therefore be acceptable, since the format was acceptable under 37 CFR 1.192 and since it specifically defines the subject matter of the relevant claims involved in the appeal. AARON C. DEDITCH (reg. no. 33,865) has filed many appeal briefs, the concise explanation for which has ultimately always been accepted by the Patent Office.* ***The Office is encouraged to contact the undersigned if there are any questions as to the description of the claimed subject matter.***

*It is noted that the Patent Office Rules do not require the Applicants to include references cited by and relied upon by the Examiner in the Evidence Appendix (although it is required by the Office for the Examiner). In the present Appeal, the Applicants have not submitted any evidence on which they intend to rely, so that the Evidence Appendix lists no evidence.*

It is respectfully submitted that this Appeal brief complies with 37 C.F.R. 41.37. Although no longer required by the rules, this Brief is submitted in triplicate as a courtesy to the Appeals Board.

It is respectfully submitted that the final rejections of pending and considered claims 42 to 45, 47 to 71 and 74 (*claims 1 to 30, 46, 72, and 73 are canceled, and claims 31 to 41 are withdrawn*) should be reversed for the reasons set forth below.

**1. REAL PARTY IN INTEREST**

The real party in interest in the present appeal is Robert Bosch GmbH ("Robert Bosch") of Stuttgart in the Federal Republic of Germany. Robert Bosch is the assignee of the entire right, title and interest in the present application.

**2. RELATED APPEALS AND INTERFERENCES**

There are no interferences or other appeals related to the present application, which "will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal".

**3. STATUS OF CLAIMS**

**CLAIMS 1 TO 30, 46, 72, AND 73 ARE CANCELED. CLAIMS 31 TO 41 ARE WITHDRAWN.**

1. Claims 42 to 45 and 47 to 71 were finally rejected under the first paragraph of 35 U.S.C. § 112 as to the written description requirement.

2. Claim 74 was rejected under 35 U.S.C. § 103(a) as obvious over Kadomura, U.S. Patent No. 5,662,819 in view of Collins et al., U.S. Patent No. 6,217,785, Wilbur, U.S. Patent No. 6,020,794, and Koshimizu, U.S. Patent No. 5,997,687.

3. Claim 74 was rejected under 35 U.S.C. § 103(a) as obvious over Savas, WO 97/14177 in view of Collins et al., U.S. Patent No. 6,217,785, Wilbur, U.S. Patent No. 6,020,794, and Koshimizu, U.S. Patent No. 5,997,687.

4. Claim 74 was rejected under 35 U.S.C. § 103(a) as obvious over Koshimizu, U.S. Patent No. 5,935,373 in view of Collins et al., U.S. Patent No. 6,217,785, Wilbur, U.S. Patent No. 6,020,794, and Koshimizu, U.S. Patent No. 5,997,687.

Appellants therefore appeal from the final rejections of pending and considered claims 42 to 45 and 47 to 71. A copy of all of the pending and considered and appealed claims 42 to 45 and 47 to 71 (as well as withdrawn claims 31 to 41) is attached hereto in the Appendix.

## 4. STATUS OF AMENDMENTS

In response to the Final Office Action mailed on August 23, 2006, a Response After A Final Office Action was mailed on January 19, 2007 in response to the Final Office Action, and an Advisory Action was mailed on March 7, 2007.

*It is understood for purposes of the appeal that any Amendments to date have already been entered by the Examiner, and that the Response After Final does not require entry since it included no amendments.*

## 5. SUMMARY OF CLAIMED SUBJECT MATTER

*The claimed subject matter is described as follows, and is directed to addressing the following problems and/or providing the following benefits, and as described in the context of the present application.*

A first exemplary embodiment of the claimed subject matter is explained with reference to Figure 1. For this purpose, a plasma etching system 5 has a reactor 15, and an inductively coupled plasma 14 is generated via an ICP source 13 (inductively coupled plasma). There is a gas supply 14 for supplying a reactive gas, a gas discharge 20, a substrate 10, for example, a silicon body or silicon wafer structured using the etching method of the presently claimed subject matter, a substrate electrode 11 is in contact with substrate 10, a substrate voltage generator 12, and a first impedance transformer 16. The radio-frequency power or AC voltage injected into substrate electrode 11 is typically between 3 watts and 50 watts and 5 volts and 100 volts. In addition, an ICP coil generator 17 is connected to a second impedance transformer 18 and via it to ICP source 13, which generates a radio-frequency electromagnetic alternating field and via it an inductively coupled plasma 14 of reactive

particles and electrically charged particles (ions) in reactor 15. The ICP source 13 has a coil having at least one turn. (See specification, page 7, line 28 to page 8, line 22).

Second impedance transformer 18 may be arranged in the manner disclosed in German Patent Application 199 00 179.0 resulting in a balanced, symmetrically structured configuration and supply of ICP source 13 via ICP coil generator 17. Thus, the high-frequency AC voltages applied to the ICP source 13 are nearly in phase opposition to each other. The anisotropic high-rate etching process for silicon with alternating etching and passivation steps (see German Patent 42 41 045 C2) is done with plasma etching system 5. (See specification, page 8, lines 24 to 37).

When substrate 10 is etched during the passivation steps, passivation is carried out in reactor 15 with a process pressure of 5 $\mu$bar to 20 $\mu$bar and at a mean plasma power of 300 to 1000 watts injected into plasma 14 via ICP source 13. Etching is then carried out at a process pressure of 30 $\mu$bar to 50 $\mu$bar and at a high mean plasma power of 1000 to 5000 watts. A spacer 22 of a non-ferromagnetic material is placed in plasma etching system 5 between inductively coupled plasma 14, i.e., ICP source 13, i.e., the actual plasma excitation zone, and substrate 10. This spacer 22 is inserted concentrically into the wall of reactor 15 as a spacer ring and thus forms the reactor wall in some areas, and may have a height of approximately 5 cm to 30 cm for a typical reactor 15 diameter of 30 cm to 100 cm. Spacer 22 is further surrounded by a magnetic field coil 21. (See specification, page 9, line 17 to page 10, line 4).

In the first embodiment, a direct current which generates a static magnetic field in the interior of reactor 15, which in the case of a magnetic field coil 21 with 100 turns, a length of 10 cm, and a diameter of 40 cm, generates, for example, a magnetic field strength in the center of magnetic field coil 21 of approximately 0.3 mTesla/A current flow. To ensure a significant increase of the plasma generation efficiency and adequate magnetic conduction of inductively coupled plasma 14, magnetic field strengths of 10 mT to 100 mT are needed. Power supply unit 23 supplies current intensities of approximately 30 to 100 amperes at least for etching a substrate 10. It is important for the direction of the magnetic field generated via magnetic field coil 21 or the permanent magnets to be at least approximately or predominantly parallel to the direction defined by the connecting line of substrate 10 and

inductively coupled plasma 14, i.e., the plasma excitation zone (longitudinal magnetic field orientation). (See specification, page 10, line 15 to page 11, line 6).

During the etching and/or passivation, ICP coil generator 17 injects a pulsed plasma power into inductively coupled plasma 14 which, on a time average, is between a minimum of 300 watts and a maximum of 5000 watts. During the pulsing, the impedance of the radio-frequency power generated via ICP coil generator 17 is continuously matched to the plasma impedance which changes as the plasma power is changed, i.e., pulsed. The frequency of the radio-frequency electromagnetic alternating field generated by ICP coil generator 17 is varied for impedance matching within a specified bandwidth. The adaptor network in the second impedance transformer 18 (which may feed ICP source 13 symmetrically) is initially adjusted so that the best impedance matching is present when the injected radio-frequency plasma power pulses have reached their maximum value. The frequency variation of the coupled electromagnetic alternating field occurs so that when the maximum values of the radio-frequency plasma power pulses are attained, stationary or resonance frequency 1'N of the radio-frequency electromagnetic alternating field generated by ICP coil generator 17 is attained simultaneously. (See specification, page 11, line 25 to page 12, line 20).

In addition, power amplifier 3 has generator control inputs 9 which are used for externally controlling ICP coil generator 17. They can be used, for example, to switch ICP coil generator 17 on and off or to specify a radio-frequency power to be generated for injecting into plasma 14. Moreover, generator status outputs 9 are for the feedback of generator data such as generator status, present output power, reflected power, overload, etc. to an external control unit (machine control), or to power supply unit 23 of plasma etching system 5. Frequency-selective component 1 is shown, for example, as a tunable arrangement of LC resonance circuits, and this passband filter has a certain specified bandwidth of, for example, 0.1 MHz to 4 MHz and a filter characteristic 1', as in Figure 3. The band filter has a resonance frequency or stationary frequency 1'N with maximum signal transmission. (See specification, page 14, line 5 to page 15, line 12).

The above-described arrangement of controlled power amplifier 3, matching network 2, ICP source 13, and band filter represents a Meissner oscillator feedback circuit, which begins to oscillate in the vicinity of stationary frequency 1'N to escalate to a specified output power of power amplifier 3. The phase relationship between the generator output and signal tap 25 required for the start of oscillation is set in advance one time. Thus, the coil of ICP source 13 is deattenuated in an optimum manner with a correct phase. For incorrect matching to the plasma impedance, for example, during rapid power changes, the frequency of the explained feedback circuit can drop back within the passband of the band filter and thus constantly maintain a largely optimum impedance matching even with rapid impedance changes of inductively coupled plasma 14. During such rapid power changes, the explained feedback circuit is activated and internal oscillator 4 of generator 17 is deactivated. (See specification, page 15, line 20 to page 16, line 33).

When inductively coupled plasma 14 is stabilized as to the plasma impedance and the injected plasma power, i.e., the frequency of ICP coil generator 17 returns to the vicinity or to the value of the maximum pass band frequency which is set by stationary frequency 1'N. This matching of the impedance by frequency variation occurs automatically and very rapidly within the microsecond range. To inject a pulsed plasma power into the inductively coupled plasma, the output power of ICP coil generator 17 is switched on and off, i.e., pulsed, periodically, for example, with a repetition frequency of typically 10 Hz to 1 MHz, such as 10 kHz to 100 kHz. (See specification, page 16, line 35 to page 17, line 17).

Another exemplary embodiment provides that in addition to the pulsing of the plasma power via the ICP coil generator, the radio-frequency power present at substrate 10 via substrate electrode 11 and produced by substrate voltage generator 12 is also pulsed and these pulsations of plasma power and substrate voltage or of plasma power, substrate voltage, and magnetic field are synchronized. In particular, pulsing of the pulsed radio-frequency power injected into substrate electrode 11 may take place so that a radio-frequency power is injected into substrate 10 via substrate voltage generator 12 only during the time of plasma power pulses generated via ICP coil generator 17. (See specification, page 20, lines 11 to 27).

Both the selected pulse to pause ratio and the maximum value of the power of an individual substrate voltage generator pulse are available as parameters for setting the radio-frequency power injected into substrate 10 on the time average. Therefore, either the maximum power during the substrate voltage generator pulses can be set to a fixed value of, for example, 1 kilowatt and the pulse to pause ratio controlled so that a preset time average of the radio-frequency power is injected into substrate 10, or conversely the pulse to pause ratio can be fixed and the maximum power during the substrate voltage generator pulses can be controlled accordingly so that this time average for power is attained. A defined setpoint of the radio-frequency power of the machine control of plasma etching system 5 to be injected into substrate 10 as an analog voltage variable is converted into a repetition frequency of individual impulses so that the mean power given off by substrate voltage generator 12 and fed back to the machine control as a time average corresponds exactly to the defined setpoint. To translate an analog voltage setpoint into a frequency, voltage-frequency converters or VCOs (voltage controlled oscillators) are used. (See specification, page 23, line 21 to page 24, line 7).

To ensure that the same high-frequency voltage curve is present within one individual pulse of substrate voltage generator 12, the electronic circuit of Figure 5 may be implemented in this embodiment additionally integrated with substrate voltage generator 12 for the synchronization of the individual pulses with the high-frequency fundamental component. In particular, a control device 32 has an integrated frequency generator, which defines a rectangular pulse signal having the frequency with which the individual pulses are to be injected into substrate 10, for example, 200 kHz. This repetition frequency may also – with a preselected fixed peak pulse power of substrate voltage generator 12 – be derived from the defined setpoint of an average power of the system control of plasma etching system 5 so that the average power given off by substrate voltage generator 12 as individual pulses and returned to the machine control corresponds to the average power defined as the setpoint, which, for example, is attained by a simple voltage-frequency conversion using appropriate calibration. (See specification, page 25, line 20 to page 26, line 5).

The advantageous effect of the radio-frequency power pulses which have a very short duration, in particular, and a high amplitude, used in the above embodiments, and which are injected into substrate 10 via substrate voltage generator 12, is based on the following mechanisms in plasma 14:

A negative DC voltage arises in relation to plasma 14 and to earth potential on a substrate electrode 11 exposed to a plasma 14 to which a high-frequency voltage or a radio-frequency power is applied via substrate voltage generator 12. This DC voltage identified as "bias voltage" or "self-bias" results from the different mobility of electrons and positive ions in the electrical alternating field. While the light electrons instantaneously follow the radio-frequency alternating field and can reach substrate electrode 11 during the positive half-waves of the AC voltage, this is increasingly less possible for the essentially heavier positive ions during the negative half-waves of the AC voltage as the frequency of the electrical alternating field increases. Consequently, a negative charge builds up on substrate electrode 11 through the surplus of arriving electrons in relation to the arriving positive ions until a saturation value of the charge occurs and the same number of electrons as positively charged ions reach substrate electrode 11 on the time average. The substrate electrode voltage corresponds to this saturation value of the negative charge. (See specification, page 28, lines 13 to 33).

With a pulse operation using high-frequency substrate voltage generator pulses, a substrate electrode voltage accordingly builds up at substrate electrode 11 of Figure 6 at the start of each pulse, the substrate electrode voltage reaching a saturation value after a number of radio-frequency oscillation periods and persisting there until the end of the pulse. After the end of the radio-frequency oscillation packet, this substrate electrode voltage then decays again during the interpulse period. The oscillation periods needed to attain a stationary substrate electrode voltage is approximately 20 to 100 oscillation periods at a radio frequency of 13.56 MHz and a high density inductively coupled plasma 14 which is in contact with the substrate electrode. When very short individual pulses are used, which encompass only a few oscillation periods, the saturation value of the substrate electrode voltage is still not attained and the substrate electrode voltage is still in the process of rising after the pulse. Figure 7 shows how the substrate electrode voltage $U_{bias}$ develops as a function of the number of

oscillation periods n of the fundamental component of the high-frequency AC voltage (13.56 MHz) injected into substrate 10. (See specification, page 29, lines 11 to 34).

The finally attained level of the local voltage in the saturation case after many oscillation periods is essentially a function of equivalent resistance R (energy dissipation into the plasma) and capacitance C of the capacitor (reactive power component) according to Figure 6. The saturation value of the substrate electrode voltage, which arises on the substrate surface after many oscillation periods, is a function of plasma resistance R (see Figure 6), i.e., of the energy dissipation into plasma 14. Thus local differences occur with regard to the energy dissipation into plasma 14, for example, between the center and edge of a substrate 10, which results in voltage gradients between various surface areas of substrate 10. These voltage gradients are essentially further intensified in that the surface of substrate 10 is electrically insulating at least in some areas during etching or is only weakly conductive as a result of frequently used dielectric masking layers (photoresist, $SiO_2$ mask, etc.). Substrate surface 10 no longer shows an equipotential surface due to the explained effects, but rather voltage gradients from the substrate center to the substrate edge have the effect of an electrical lens in relation to plasma 14, which results in a deflection of the ions accelerated to the substrate from the vertical and in a fault of the produced etching profiles. (See specification, page 29, line 36 to page 30, line 26).

Thus, as explained above, claim 42 is to a method for etching a silicon body substrate using a device having an ICP source for generating a radio-frequency electromagnetic alternating field, a reactor for generating an inductively coupled plasma from reactive particles by the action of the radio-frequency electromagnetic alternating field on a reactive gas, and a first means for generating plasma power pulses to be injected into the inductively coupled plasma by the ICP source, comprising: matching an impedance of one of an inductive coupled plasma and the ICP source to an ICP coil generator; and injecting a pulsed radio-frequency power into the inductively coupled plasma as a pulsed plasma power; in which the pulsing of the injected, pulsed radio-frequency power is accompanied by a change of a frequency of the injected, pulsed radio-frequency power, the change in the frequency being controlled so that the plasma power injected into the inductively coupled plasma during

the pulsing is maximized; in which the ICP coil generator causes a variation of the frequency of the radio-frequency electromagnetic alternating field so that the impedance is matched as a function of the pulsed plasma power to be injected, so as to provide rapid switching between the pulses of the pulsed plasma power and interpulse periods; in which the variation of the frequency is automatically performed by a Meissner oscillator feedback loop between the ICP coil and the ICP coil generator input without measuring the ratio of magnitudes of applied and reflected power of the generator. **(see claim 42).**

*Finally, the appealed claims include no means-plus-function language and no step-plus-function claims, so that 41.37(v) is satisfied as to its specific requirements for such claims, since none are present here. Also, the present application does not contain any step-plus-function claims because the method claims in the present application are not "step plus function" claims because they do not recite "a step for", as required by the Federal Circuit and as stated in Section 2181 of the MPEP.*

## 6. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

1. Whether claims 42 to 45 and 47 to 71 were properly rejected under the first paragraph of 35 U.S.C. § 112 as to the written description requirement.

2. Whether claim 74 under 35 U.S.C. § 103(a) is unpatentable over Kadomura, U.S. Patent No. 5,662,819 in view of Collins et al., U.S. Patent No. 6,217,785, Wilbur, U.S. Patent No. 6,020,794, and Koshimizu, U.S. Patent No. 5,997,687.

3. Whether claim 74 under 35 U.S.C. § 103(a) is unpatentable over Savas, WO 97/14177 in view of Collins et al., U.S. Patent No. 6,217,785, Wilbur, U.S. Patent No. 6,020,794, and Koshimizu, U.S. Patent No. 5,997,687.

4. Whether claim 74 under 35 U.S.C. § 103(a) is unpatentable over Koshimizu, U.S. Patent No. 5,935,373 in view of Collins et al., U.S. Patent No. 6,217,785, Wilbur, U.S. Patent No. 6,020,794, and Koshimizu, U.S. Patent No. 5,997,687.

7. **ARGUMENT**

**A. The Written Description Rejections Under The First Paragraph of 35 U.S.C. § 112 As To Claims 42 to 45, 47 to 71**

**Claims 42 to 45, 47 to 71**

The Office bears the initial burden of presenting "evidence or reasons why persons skilled in the art would not recognize in an applicant's disclosure a description of the invention defined by the claims." (See M.P.E.P. § 2163.04 (citing In re Wertheim 541 F.2d 257, 262, 265, 191 U.S.P.Q. 90, 96, 98 (C.C.P.A. 1976))) (emphasis added).

It is respectfully submitted that the Final Office Action's arguments and assertions simply do not identify why the rejected claims are not supported by the written description of the present application (and its specification) — which it plainly is, as explained herein.

The Manual of Patent Examining Procedure specifically provides that if the Office rejects a claim based on the lack of a written description, the examiner should "identify the claim limitation not described" and also provide "*reasons why persons skilled in the art would not recognize the description of this limitation in the disclosure of the application.*" (See id.).

In this regard, the Final Office Action does not explain why a person skilled in the art would not recognize the exclusionary feature of claim 42. The Final Office Action also does not even address (let alone refute) the fact that since, for example, the specification (see pages 3 to 5) specifically discusses the reflected power problem, makes plain that it solves this problem by using, for example, frequency variation, so that there is no reference to solving the problem by using the prior reference approach of measuring the ratio of magnitudes of applied and reflected power of the generator -- which the Final Office Action only conclusorily asserts would have been known by those skilled in the art.

As stated by the Board in Ex parte Harvey, 3 U.S.P.Q. 2d 1626, 1627 (Bd. Pat. App. Int. 1986) (emphasis added, citations omitted):

> Compliance with the written description requirement of Section 112 only requires that appellant's application contain sufficient disclosure, *expressly or inherently*, to make it clear to persons skilled in the art that appellant possessed the subject matter claimed. The test for determining compliance with the written description requirement is whether the disclosure of the application as originally filed reasonably conveys to the artisan that the inventor had possession of the claimed subject matter, *rather than the presence or absence of literal support in the specification for the claimed language.*

Likewise, as stated by the Board in Ex parte Sorenson, 3 U.S.P.Q. 2d 1462, 1463 (Bd. Pat. App. Int. 1987) (emphasis added):

> [W]e are mindful that appellant's specification need not describe the claimed invention in *ipsis verbis* to comply with the written description requirement. *The test is whether the originally filed specification disclosure reasonably conveys to a person having ordinary skill that applicant had possession of the subject matter later claimed.* . . . Moreover, the Examiner has the initial burden of presenting evidence or reasons why persons skilled in the art would not recognize in appellant's specification disclosure a description of the invention defined by the claims.

In particular, the Sorenson Board, noting that the examiner only essentially stated that the claim expressions at issue did not "appear in the original disclosure" and that the claim expressions were therefore "not adequately supported by the few specific compounds in the specification", found that the examiner had not met his initial burden of "presenting evidence why a person having ordinary skill in the art would not recognize in appellant's specification a description of the invention defined by the claims" — and that the "only reasoning presented" that the Board could discern was an "example of *ipse dixit* reasoning, resting on a bare assertion by the Examiner".

In view of all of the foregoing, it is respectfully submitted that the Final Office Action's arguments and assertions do not satisfy the evidentiary and judicial standards discussed above, and it is respectfully submitted that the Final Office Action does not

establish a prima facie written description case with respect to the present application. It is therefore respectfully submitted that the present application does satisfy the written description requirement of 35 U.S.C. § 112. Accordingly, it is respectfully submitted that the "written description" rejection of the claims should be reversed.

It is therefore respectfully submitted that the Final Office Action's arguments and assertions simply do not explain why the subject matter of the rejected claims is not supported by the written description of the present application — which it plainly is for the reasons explained herein.

### B. The "Kadomura"/"Collins"/"Koshimizu" Rejection Under 35 U.S.C. § 103(a) Of Claim 74

**Claim 74**

Claim 74 was rejected under 35 U.S.C. § 103(a) as obvious over Kadomura, U.S. Patent No. 5,662,819 in view of Collins et al., U.S. Patent No. 6,217,785, Wilbur, U.S. Patent No. 6,020,794, and Koshimizu, U.S. Patent No. 5,997,687.

Independent claim 74 is supported by the present application (including, for example, the specification at pages 3 to 5), and includes the feature which provides that *the variation of the frequency is such as to avoid high reflected powers back into the ICP coil generator when the plasma power is pulsed*. This feature, as provided for in the context of claim 74, is in no way described or even suggested by any of the references applied to date.

Accordingly, claim 74 is allowable over the references applied to date, since they do not in any way disclose or suggest this feature.

As to the rejections in the Final Office Action, the rejections simply and conclusorily assert that this feature is somehow met by the combination of references -- *but provides no explanation or citations whatsoever as to how this is so*, and therefore essentially admits that the references provide no specific disclosure whatsoever as to these features of claim 74. It is respectfully submitted that any review of the references makes plain that they nowhere disclose or suggest the claim 74 features, so that claim 74 is allowable.

### C. The "Savas"/"Collins"/"Koshimizu" Rejection Under 35 U.S.C. § 103(a) Of Claim 74

**Claim 74**

Claim 74 was rejected under 35 U.S.C. § 103(a) as obvious over Savas, WO 97/14177 in view of Collins et al., U.S. Patent No. 6,217,785, Wilbur, U.S. Patent No. 6,020,794, and Koshimizu, U.S. Patent No. 5,997,687.

Claim 74 is allowable over the references applied to date, since they do not in any way disclose or suggest the feature which provides that *the variation of the frequency is such as to avoid high reflected powers back into the ICP coil generator when the plasma power is pulsed*.

As to the rejections in the Final Office Action, the rejections simply and conclusorily assert that this feature is somehow met by the combination of references -- *but provides no explanation or citations whatsoever as to how this is so*, and therefore essentially admits that the references provide no specific disclosure whatsoever as to these features of claim 74. It is respectfully submitted that any review of the references makes plain that they nowhere disclose or suggest the claim 74 features, so that claim 74 is allowable.

### D. The "Koshimizu '373"/"Collins"/"Koshimizu" Rejection Under 35 U.S.C. § 103(a) Of Claim 74

**Claim 74**

Claim 74 was rejected under 35 U.S.C. § 103(a) as obvious over Koshimizu, U.S. Patent No. 5,935,373 in view of Collins et al., U.S. Patent No. 6,217,785, Wilbur, U.S. Patent No. 6,020,794, and Koshimizu, U.S. Patent No. 5,997,687.

Claim 74 is allowable over the references applied to date, since they do not in any way disclose or suggest the feature which provides that *the variation of the frequency is such*

*as to avoid high reflected powers back into the ICP coil generator when the plasma power is pulsed*.

As to the rejections in the Final Office Action, the rejections simply and conclusorily assert that this feature is somehow met by the combination of references -- *but provides no explanation or citations whatsoever as to how this is so*, and therefore essentially admits that the references provide no specific disclosure whatsoever as to these features of claim 74. It is respectfully submitted that any review of the references makes plain that they nowhere disclose or suggest the claim 74 features, so that claim 74 is allowable.

As further regards all of the obviousness rejections discussed herein, in rejecting a claim under 35 U.S.C. § 103(a), the *Office* bears the initial burden of presenting a prima facie case of obviousness. In re Rijckaert, 9 F.3d 1531, 1532, 28 U.S.P.Q.2d 1955, 1956 (Fed. Cir. 1993). To establish prima facie obviousness, three criteria must be satisfied. First, there must be some suggestion or motivation to modify or combine reference teachings. In re Fine, 837 F.2d 1071, 5 U.S.P.Q.2d 1596 (Fed. Cir. 1988). This teaching or suggestion to make the claimed combination must be found in the prior art and not based on the application disclosure. In re Vaeck, 947 F.2d 488, 20 U.S.P.Q.2d 1438 (Fed. Cir. 1991). Second, there must be a reasonable expectation of success. In re Merck & Co., Inc., 800 F.2d 1091, 231 U.S.P.Q. 375 (Fed. Cir. 1986). Third, the prior art reference(s) must teach or suggest all of the claim features. In re Royka, 490 F.2d 981, 180 U.S.P.Q. 580 (C.C.P.A. 1974). Thus, to reject a claim as obvious under 35 U.S.C. § 103, the prior art must disclose or suggest each claim element and it must also suggest combining the features in the manner contemplated by the claim. (See Northern Telecom, Inc. v. Datapoint Corp., 908 F.2d 931, 934 (Fed. Cir. 1990), cert. denied, 111 S. Ct. 296 (1990); In re Bond, 910 F.2d 831, 834 (Fed. Cir. 1990)).

Moreover, the "problem confronted by the inventor must be considered in determining whether it would have been obvious to combine the references in order to solve the problem." (See Diversitech Corp. v. Century Steps, Inc., 850 F.2d 675, 679 (Fed. Cir. 1998)). It is respectfully submitted that, as discussed above, the references relied on, whether taken alone or combined, do not suggest in any way modifying or combining the references so as to provide the presently claimed subject matter for addressing the problems

and/or providing the benefits of the dynamic addressing feature of the claimed subject matter as explained herein and in the specification.

More recently, the Federal Circuit in the case of In re Kotzab has made plain that even if a claim concerns a "technologically simple concept" — which is not even the case here, there still must be some finding as to the "specific understanding or principle within the knowledge of a skilled artisan" that would motivate a person having no knowledge of the claimed subject matter to "make the combination in the manner claimed", stating that:

> In this case, the Examiner and the Board fell into the hindsight trap. The idea of a single sensor controlling multiple valves, as opposed to multiple sensors controlling multiple valves, is a technologically simple concept. *With this simple concept in mind, the Patent and Trademark Office found prior art statements that in the abstract appeared to suggest the claimed limitation. But, there was no finding as to the specific understanding or principle within the knowledge of a skilled artisan that would have motivated one with no knowledge of Kotzab's invention to make the combination in the manner claimed.* In light of our holding of the absence of a motivation to combine the teachings in Evans, we conclude that the Board did not make out a proper *prima facie* case of obviousness in rejecting [the] claims . . . under 35 U.S.C. Section 103(a) over Evans.

(See In re Kotzab, 55 U.S.P.Q.2d 1313, 1318 (Federal Circuit 2000) (italics added)). Here again, it is believed that there have been no such findings to establish that the features discussed above of the rejected claims are met by the reference relied upon. As referred to above, any review of the reference relied upon makes plain that it simply does not describe the features discussed above of the claims as now presented.

Thus, the proper evidence of obviousness must show why there is a suggestion as to the reference so as to provide the subject matter of the claimed subject matter and its benefits.

In short, there is no evidence that the reference relied upon, whether taken alone or otherwise, would provide the features of the claims discussed above. It is therefore respectfully submitted that the claims are allowable for these reasons.

As further regards all of the obviousness rejections of the claims, it is respectfully submitted that not even a *prima facie* case has been made in the present case for obviousness,

since the Office Actions to date never made any findings, such as, for example, regarding in any way whatsoever what a person having ordinary skill in the art would have been at the time the claimed subject matter of the present application was made. (See *In re Rouffet*, 47 U.S.P.Q.2d 1453, 1455 (Fed. Cir. 1998) (the "factual predicates underlying" a *prima facie* "obviousness determination include the scope and content of the prior art, the differences between the prior art and the claimed invention, and the level of ordinary skill in the art")). It is respectfully submitted that the proper test for showing obviousness is what the "combined teachings, knowledge of one of ordinary skill in the art, and the nature of the problem to be solved as a whole would have suggested to those of ordinary skill in the art", and that the Patent Office must provide particular findings in this regard — the evidence for which does not include "broad conclusory statements standing alone". (See *In re Kotzab*, 55 U.S.P.Q. 2d 1313, 1317 (Fed. Cir. 2000) (citing *In re Dembiczak*, 50 U.S.P.Q.2d 1614, 1618 (Fed. Cir. 1999) (obviousness rejections reversed where no findings were made "concerning the identification of the relevant art", the "level of ordinary skill in the art" or "the nature of the problem to be solved"))). It is respectfully submitted that there has been no such showings by the Office Actions to date or by the Advisory Action.

In fact, the present lack of any of the required factual findings forces both Appellants and any Appeals Board to resort to unwarranted speculation to ascertain exactly what facts underly the present obviousness rejections. The law mandates that the allocation of the proof burdens requires that the Patent Office provide the factual basis for rejecting a patent application under 35 U.S.C. § 103. (See *In re Piasecki*, 745 F.2d 1468, 1472, 223 U.S.P.Q. 785, 788 (Fed. Cir. 1984) (citing *In re Warner*, 379 F.2d 1011, 1016, 154 U.S.P.Q. 173, 177 (C.C.P.A. 1967))).

In short, the Examiner bears the initial burden of presenting a proper prima facie unpatentability case — which has not been met in the present case. (See *In re Oetiker*, 977 F.2d 1443, 1445, 24, U.S.P.Q.2d 1443, 1444 (Fed. Cir. 1992)).

Accordingly, claim 74 is allowable.

In short, claims 42 to 45, 47 to 71 and new claim 74 are allowable for all of the above reasons.

## CONCLUSION

In view of the above, it is respectfully requested that the rejections of claims 42 to 45, 47 to 71 and 74 be reversed, and that these claims be allowed as ~~presented.~~

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Respectfully submitted,

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**CUSTOMER NO. 26646**

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**[10191/1690]**

## CLAIMS APPENDIX

1-30. (Canceled).

31. (Withdrawn) A device for etching a silicon body substrate (10) using an inductively coupled plasma (14), comprising: an ICP source (13) for generating a radio-frequency electromagnetic alternating field; a reactor (15) for generating the inductively coupled plasma (14) from reactive particles by the action of the radio-frequency electromagnetic alternating field on a reactive gas, and a first means for generating plasma power pulses to be injected into the inductively coupled plasma (14) by the ICP source (13).

32. (Withdrawn) The device according to Claim 31, wherein the first means is an ICP coil generator (17) which generates a variably adjustable, pulsed radio-frequency power with regard to the pulse to pause ratio of the plasma power pulses or the individual pulse power.

33. (Withdrawn) The device according to Claim 32, further comprising an impedance transformer (18) in the form of a balanced symmetrical matching network for matching an initial impedance of the ICP coil generator (17) to a plasma impedance which is dependent on the individual pulse power of the plasma power pulses to be injected.

34. (Withdrawn) The device according to Claim 33, wherein the impedance transformer (18) is preset in such a way that with a specified maximum individual pulse power of the plasma power pulses to be injected into the inductively coupled plasma (14) in the case of stationary power, a substantially optimum impedance matching is ensured.

35. (Withdrawn) The device according to Claim 32, wherein components are integrated into the ICP coil generator (17) which, via a variation of the frequency of the generated electromagnetic alternating field, perform impedance matching as a function of the individual pulse power to be injected.

36. (Withdrawn) The device according to Claim 35, wherein the ICP coil generator (17) includes an automatically acting feedback circuit having a frequency-selective

component (1), the feedback circuit having at least one controlled power amplifier, a frequency-selective band filter with a stationary frequency (1 'N) to be attained and a delay line (7) or a phase shifter.

37. (Withdrawn) The device according to Claim 31, further comprising a second means for generating a static or time-variable, particularly pulsed magnetic field between the substrate (10) and the ICP source (13).

38. (Withdrawn) The device according to Claim 37, wherein the first means is a magnetic field coil (21) with an associated power supply unit (23) or a permanent magnet, the magnetic field generated by the magnetic field coil (21) via the power supply unit (23) being time-variable, capable of being pulsed in particular.

39. (Withdrawn) The device according to Claim 31, further comprising a substrate voltage generator (12) which can apply a continuous or time-variable radio-frequency power, a pulsed radio-frequency power in particular, to a substrate (10) arranged on a substrate electrode (11).

40. (Withdrawn) The device according to Claim 39, further comprising a first impedance transformer (12) for impedance matching between the substrate voltage generator (12) and the substrate (10).

41. (Withdrawn) The device according to Claim 39, wherein an ICP coil generator (17) is connected to the substrate voltage generator (12) or a power supply unit (23).

42. (Previously Presented) A method for etching a silicon body substrate using a device having an ICP source for generating a radio-frequency electromagnetic alternating field, a reactor for generating an inductively coupled plasma from reactive particles by the action of the radio-frequency electromagnetic alternating field on a reactive gas, and a first means for generating plasma power pulses to be injected into the inductively coupled plasma by the ICP source, comprising:

matching an impedance of one of an inductive coupled plasma and the ICP source to an ICP coil generator; and

injecting a pulsed radio-frequency power into the inductively coupled plasma as a pulsed plasma power;

wherein the pulsing of the injected, pulsed radio-frequency power is accompanied by a change of a frequency of the injected, pulsed radio-frequency power, the change in the frequency being controlled so that the plasma power injected into the inductively coupled plasma during the pulsing is maximized;

wherein the ICP coil generator causes a variation of the frequency of the radio-frequency electromagnetic alternating field so that the impedance is matched as a function of the pulsed plasma power to be injected, so as to provide rapid switching between the pulses of the pulsed plasma power and interpulse periods;

wherein the variation of the frequency is automatically performed by a Meissner oscillator feedback loop between the ICP coil and the ICP coil generator input without measuring the ratio of magnitudes of applied and reflected power of the generator.

43. (Previously Presented) The method according to Claim 42, wherein the pulsed plasma power is injected via an ICP source to which a radio-frequency electromagnetic alternating field having a constant frequency or a frequency which varies within a frequency range is applied around a stationary frequency.

44. (Previously Presented) The method according to Claim 42, wherein the pulsed radio-frequency power is generated with an ICP coil generator which is pulse-operated with a frequency of 10 Hz to 1 MHz and pulse to pause ratio of 1:1 to 1:100.

45. (Previously Presented) The method according to Claim 42, wherein a plasma power of 300 watts to 5000 watts on a time average is injected into the inductively coupled plasma and that the generated individual pulse powers of the radio-frequency power pulses are between 300 watts and 20 kilowatts.

46. (Canceled).

47. (Previously Presented) The method according to Claim 42, wherein during the etching, one of a static and time-variable magnetic field is generated, the direction of which is at least one of approximately and predominantly parallel to a direction defined by the connecting line of the substrate and the inductively coupled plasma.

48. (Previously Presented) The method according to Claim 47, wherein the magnetic field is generated in such a way that it extends into the area of the substrate and the inductively coupled plasma and has a field strength amplitude between 10-mTesla and 100. mTesla in the interior of the reactor.

49. (Previously Presented) The method according to Claim 47, wherein a magnetic field pulsed at a frequency of 10 Hz to 20 kHz is generated via the power supply unit, the pulse to pause ratio when the magnetic field is pulsed being between 1:1 and 1:100.

50. (Previously Presented) The method according to Claim 42, wherein one of a constant and time-variable radio-frequency power is applied to the substrate via a substrate voltage generator.

51. (Previously Presented) The method according to Claim 50, wherein the pulse duration of the radio-frequency power injected into the substrate is between one to one hundred times the period of oscillation of the high-frequency fundamental component of the radio-frequency power.

52. (Previously Presented) The method according to Claim 50, wherein the radio-frequency power applies a time-average power of 5 watts to 100 watts to the substrate, a maximum power of an individual radio-frequency power pulse being one to 20 times the time average power.

53. (Previously Presented) The method according to Claim 51, wherein the frequency of the injected radio-frequency power is between 100 kHz to 100 MHz and a pulse-to-pause ratio of the injected radio-frequency pulses is between 1:1 and 1:100.

54. (Previously Presented) The method according to Claim 42, wherein the pulsing of the injected plasma power and one of the pulsing of the radio-frequency power injected into the substrate via the substrate voltage generator and a pulsing of a magnetic field, the pulsing of the injected plasma power and the pulsing of the radio-frequency power injected into the substrate via the substrate voltage generator are one of time-correlated and synchronized with each other.

55. (Previously Presented) The method according to Claim 54, wherein the correlation takes place in such a way that the magnetic field is first applied, before a radio-frequency power pulse of the ICP coil generator, and the magnetic field is switched off again after the decay of this radio-frequency power pulse.

56. (Previously Presented) The method according to Claim 54, wherein the correlation takes place in such a way that during a radio-frequency power pulse of the ICP coil generator, the radio-frequency power injected into the substrate via the substrate voltage generator is switched off and/or that during a radio-frequency power pulse injected into the substrate via the substrate voltage generator, the radio-frequency power injected via the ICP coil generator is switched off.

57. (Previously Presented) The method according to Claim 54, wherein the synchronization takes place in such a way that during each time of a plasma power pulse injected into the plasma via the ICP coil generator, radio-frequency pulses injected into the substrate via the substrate voltage generator are also applied to the substrate.

58. (Previously Presented) The method according to Claim 54, wherein the correlation takes place in such a way that the radio-frequency power injected into the substrate via the substrate voltage generator is generated in each case during a power rise and/or a power drop of a radio-frequency power pulse injected into the plasma via the ICP coil generator.

59. (Previously Presented) The method according to Claim 54, wherein the correlation takes place in such a way that during the time of the plasma power pulses injected

into the plasma via the ICP coil generator and during the time of the pulse pauses between the individual plasma power pulses injected into the plasma via the ICP coil generator, at least one radio-frequency power pulse injected into the substrate via the substrate voltage generator is applied to the substrate in each case.

60. (Previously Presented) The method according to Claim 42, wherein the etching takes place in alternating etching and passivation steps at a process pressure of 5 $\mu$bar to 100 $\mu$bar.

61. (Previously Presented) The method according to Claim 45, wherein the radio-frequency power pulses are between 2 kilowatts to 10 kilowatts.

62. (Previously Presented) The method according to Claim 47, wherein one of the static and time-variable magnetic field is one of periodically varying and pulsed magnetic field.

63. (Previously Presented) The method according to Claim 50, wherein one of the constant and time-variable radio frequency power is a pulsed, radio-frequency power.

64. (Previously Presented) The method according to Claim 50, wherein a pulse duration of the radio-frequency power injected into the substrate is between one to ten times a period of oscillation of the high-frequency fundamental component of the radio-frequency power.

65. (Previously Presented) The method according to Claim 51, wherein the pulse duration is between one to ten times.

66. (Previously Presented) The method according to Claim 52, wherein the maximum power of an individual radio-frequency power pulse is between twice to 10 times the time average power.

67. (Previously Presented) The method according to Claim 53, wherein the frequency of the injected radio-frequency power is 13.56 MHz.

68. (Previously Presented) The method according to Claim 53, wherein the pulse-to-pause ratio of the injected radio-frequency pulses is between 1:1 and 1:10.

69. (Previously Presented) The method according to Claim 42, wherein the pulsed plasma power is in a kilowatt range.

70. (Previously Presented) The method according to Claim 42, wherein the pulsed plasma power is above 3 kilowatts.

71. (Previously Presented) The method according to Claim 42, wherein the ICP coil generator includes integrated components.

72. (Canceled).

73. (Canceled).

74. (Previously Presented) A method for etching a silicon body substrate using a device having an ICP source for generating a radio-frequency electromagnetic alternating field, a reactor for generating an inductively coupled plasma from reactive particles by the action of the radio-frequency electromagnetic alternating field on a reactive gas, and a first means for generating plasma power pulses to be injected into the inductively coupled plasma by the ICP source, comprising:

matching an impedance of one of an inductive coupled plasma and the ICP source to an ICP coil generator; and

injecting a pulsed radio-frequency power into the inductively coupled plasma as a pulsed plasma power;

wherein the pulsing of the injected, pulsed radio-frequency power is accompanied by a change of a frequency of the injected, pulsed radio-frequency power, the change in the frequency being controlled so that the plasma power injected into the inductively coupled plasma during the pulsing is maximized;

wherein the ICP coil generator causes a variation of the frequency of the radio-frequency electromagnetic alternating field so that the impedance is matched as a function of

the pulsed plasma power to be injected, so as to provide rapid switching between the pulses of the pulsed plasma power and interpulse periods,

wherein the variation of the frequency is automatically performed by a Meissner oscillator feedback loop between the ICP coil and the ICP coil generator input, and

wherein the variation of the frequency is such as to avoid high reflected powers back into the ICP coil generator when the plasma power is pulsed.

## EVIDENCE APPENDIX

Appellants have not submitted any evidence pursuant to 37 C.F.R. §§ 1.130, 1.131 or 1.132, and do not rely upon evidence entered by the Examiner.

## RELATED PROCEEDINGS INDEX

There are no interferences or other appeals related to the present application.